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GB 2317934 A GB 0814022 A WO 96/36831 A1
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(54) Abstract Title
A seal for an annulus between inner and outer pipes

(57) A gasket for sealing the annular space between two concentric pipes comprising an annular elastomeric member (10) and compression members (20, 22). Under action of a bolt (30) the two compression means can be brought together thereby deforming the elastomeric member until it engages the surfaces of the pipes (not shown). The elastomeric member and the two compression members have complementary profiles, end faces (16, 18) of the elastomeric member are concave to engage the internal convex faces of the compression members. The elastomeric member may include a void on the radial edges (see fig. 2) which can contain an additional filler ring (32, 34, fig. 4) to engage the pipe surfaces instead of the elastomeric member. The elastomeric member may also be formed in two or more parts (see fig. 3). The compression members can be unitary or may be divided into a series of arcuate portions around the annulus with upper and lower arcuate portions staggered.

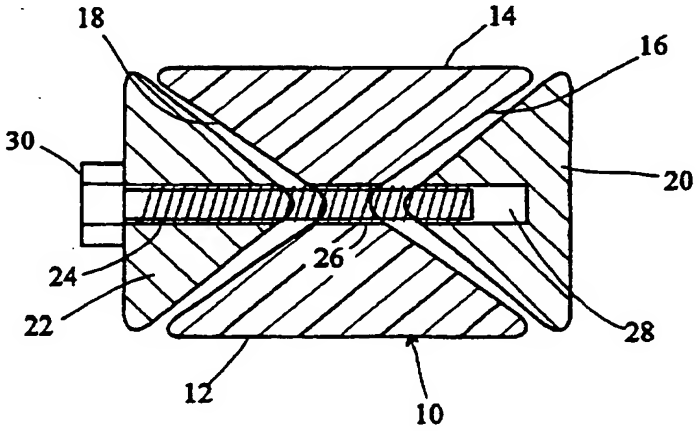

Fig 1

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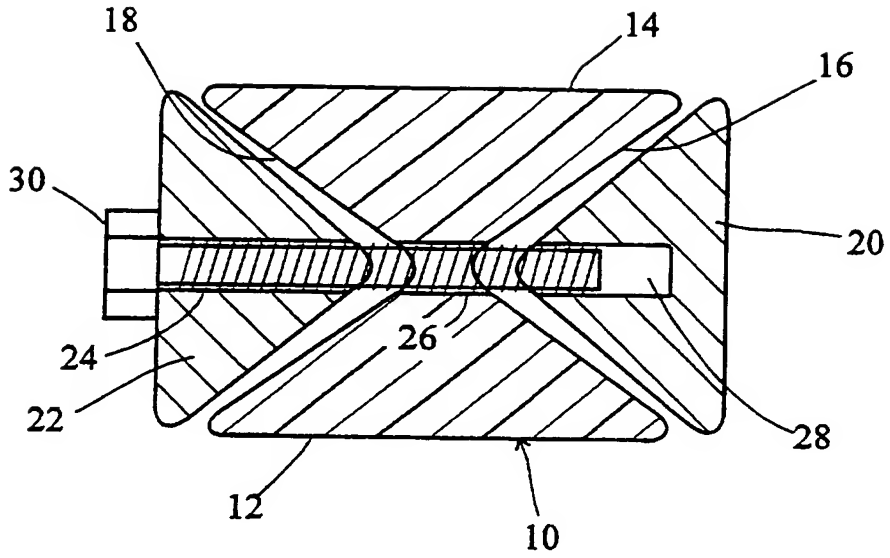

Fig 1

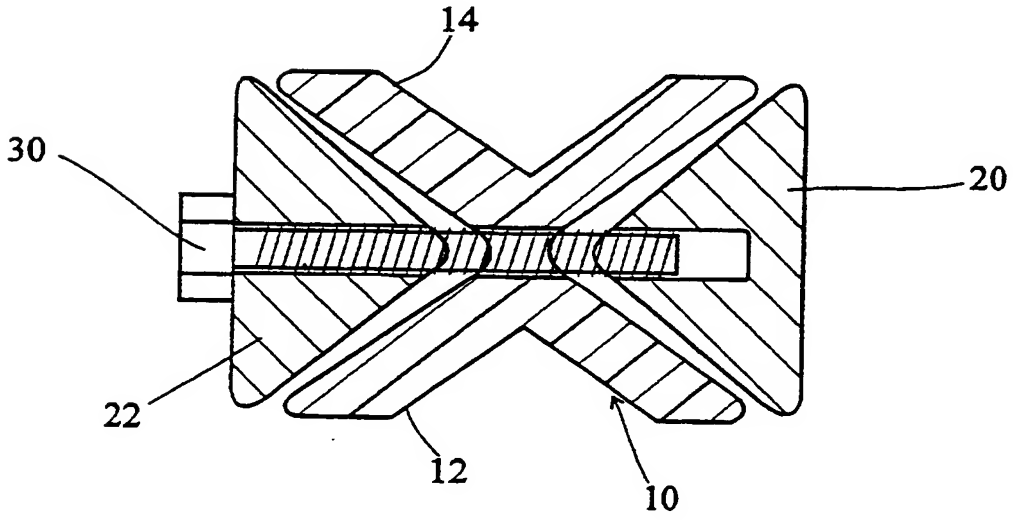

Fig 2

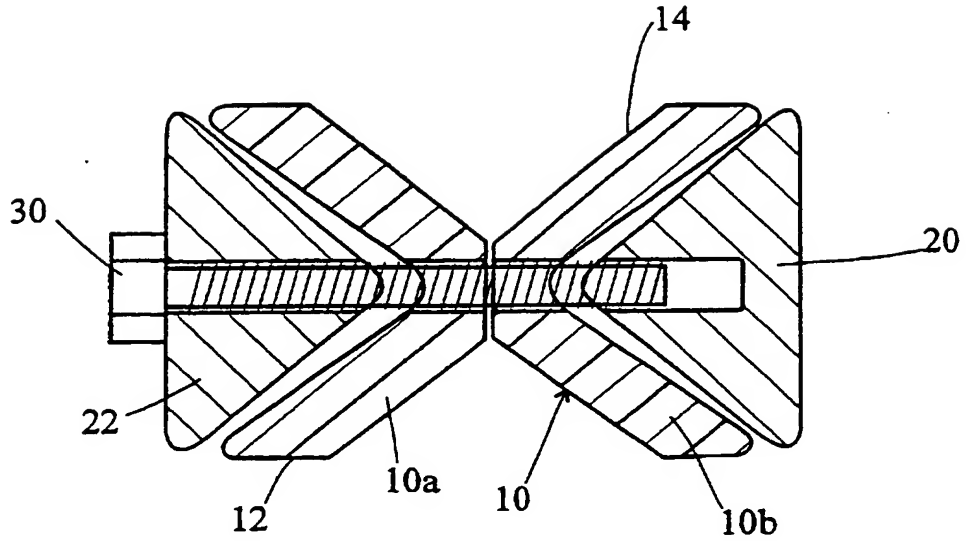

Fig 3

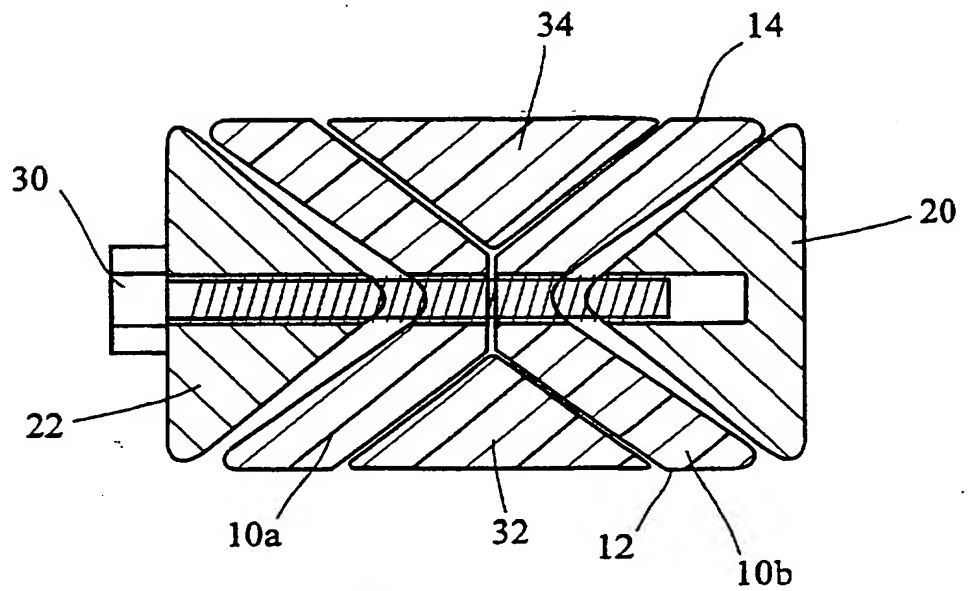

Fig 4

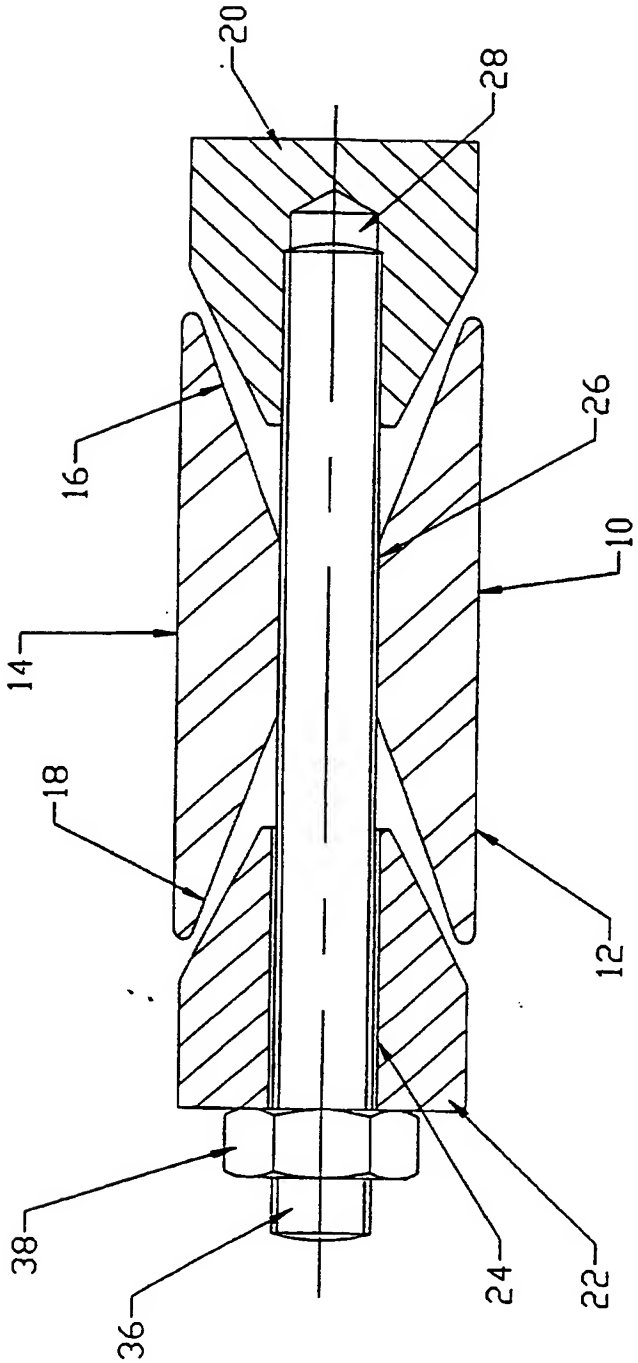

Fig 5.

GASKET

The present invention relates to a gasket for use in sealing an annular space between two pipes.

This is a problem which is commonly encountered in the offshore oil and gas industry. Crude oil typically emerges from undersea fields at between 100 and 200°C. This crude oil will include low melting point fractions which will solidify within the pipe if the oil is allowed to cool to the temperature of the surrounding water. Therefore, it is necessary to insulate the pipe. This is usually done by providing a double-walled pipe structure in which an inner flow pipe carries the crude oil and an outer sleeve pipe so as to define an annular space external to the inner flow pipe. This annular space is then filled with suitable insulating material.

It is necessary to guard against ingress of water into the annular space. Clearly, if water is allowed into the annular space it will conduct heat from the inner flow pipe to the outer sleeve pipe and destroy the effectiveness of the insulation. Any such accidental water leakages therefore need to be limited to short lengths of pipe. There is therefore a requirement for a waterstop gasket to seal the annular region. Such gaskets are typically inserted at intervals of 12m or so. Our earlier application published as WO 96/36831 describes a gasket comprising an annular ring of elastomeric material with flat compression members either side. The compression members are drawn together using bolts, and this compresses

the elastomeric member longitudinally. The resulting radial expansion seals against the flow pipe and sleeve pipe. This waterstop gasket is suitable for double-walled pipe structures in which the annular gap is approximately 100mm. There is a requirement for a waterstop for use with double-walled pipe systems in which the annular gap is approximately 50mm. In these situations, the design of WO 96/36831 can sometimes provide insufficient sealing when scaled down appropriately.

The present invention therefore provides a gasket for sealing an annular space between two pipes, comprising an annular elastomeric member having a concave formation on at least one longitudinal end face, compression members adjacent the longitudinal end faces and connected via a plurality of securing means adapted to urge the compression members together, the compression member or members adjacent a concave formation on the elastomeric member including a corresponding convex formation.

Preferably, the elastomeric member is unitary, but it is possible to design a suitable gasket in which the elastomeric member is made up of several components.

The elastomeric member can also include a concave formation on at least one radial face. In that case, the gasket can further include at least one filler member in that concave formation, on the radial face. The filler member is preferably elastomeric.

The securing means preferably comprise threaded members passing through at least one of the compression members and through the elastomeric member. These can be bolts, either passing through both compression members and retained by a suitable nut, or (preferably) extending into an internally threaded blind hole on one of the compression members. This eliminates a leakage path adjacent the bolt. Alternatively,

the threaded members can be in the form of studding, secured at one or both ends (as before) with a suitable nut.

The compression members are preferably steel.

The steel compression members can each be unitary, ie in the form of a ring, or they can be divided into a plurality of individual arcuate members. Such division of the compression members gives rise to the advantages set out in WO 96/36831. If the compression numbers are divided, individual arcuate portions on either side of the elastomeric member are preferably staggered.

Embodiments of the present invention will now be described, by way of example, with reference to the accompanying Figures, in which;

Figure 1 is a cross-section through a first embodiment of the present invention;

Figure 2 is a cross-section through a second embodiment of the present invention;

Figure 3 is a cross-section through a third embodiment of the present invention;

Figure 4 is a cross-section through a fourth embodiment of the present invention; and

Figure 5 is a cross-section through a fifth embodiment of the present invention.

Referring to Figure 1, this shows an elastomeric member 10 which is essentially ring shaped and dimensioned to fit within the annular space for

which it is intended. Thus, the distance between the radial inner and outer faces 12, 14 respectfully will be slightly less than the corresponding distance in the double-walled pipe structure.

The longitudinal end faces 16, 18 are formed into a concave V-profile. Adjacent the concave V-profile are ring-shaped steel compression members 20, 22, the internal faces of which are formed with a convex V-shape corresponding to the shape of the longitudinal faces 16, 18 of the elastomeric member 10. However, the angle of the concave V-section of the elastomeric member 10 is slightly more acute than the angle of the convex V-shape of the compression members 20, 22.

At intervals around the ring-shaped compression members 20, 22, a through hole 24 is formed in the member 22, aligned with a through hole 26 in the elastomeric member 10 and a blind hole 28 in the other compression member 20. The blind hole 28 is internally threaded. A bolt 30 is passed through the hole 24 in the compression member 22, through the hole 26 in the elastomeric member 10, and is received in the thread of the blind hole 28. Tightening of the bolt therefore urges the compression members 20, 22 together, provided longitudinal compression to the elastomeric member 10. This, in combination with the differentiation of the angles of the respective concave and convex formations, forces the radial faces 12, 14 of the elastomeric member 10 outwardly. This provides a suitable seal against the flow within the pipes (not shown).

Figure 2 shows a second embodiment of the present invention. It is generally similar to Figure 1, and therefore like reference numerals are used to denote like parts. In Figure 2, the radial faces 12, 14 of the elastomeric member 10 are formed with corresponding concave formations. As illustrated, these are simple V-formations but this is not essential and a more rounded profile could be provided if desired.

These concave formations impart additional flexibility to the elastomeric member 10 and thus magnify the radial movement of the elastomeric material. Thus, this design may be more suitable for still narrower annular gaps.

Figure 3 shows a third embodiment of the present invention, generally similar to the second. In this embodiment, the elastomeric member 10 is divided into two segments 10a, 10b at the narrowest point of the concave segments of the radial faces 12, 14. Such a configuration may be easier to manufacture and assemble.

This variation on the second embodiment could of course be applied equally to the first embodiment.

Figure 4 shows a fourth embodiment of the present invention, generally similar to the third but in which additional filler members 32, 34 are placed in the concave spaces formed in the radial faces 12, 14. This arrangement will operate generally similarly to the second embodiment, with similar advantages, and could equally be applied to the second embodiment rather than to the third as illustrated. Compression of the elastomeric members 10a, 10b should cause the outer filler member 34 to expand in the hoop direction and be compressed against the sleeve pipe. Likewise, the inner filler member 32 will be compressed in the hoop direction and compressed against the flow pipe. Sealing between the filler members 32, 34 and the elastomeric members 10a, 10b will be by longitudinal compression along the adjacent faces, caused by the bringing together of the compression members 20, 22.

Figure 5 show a fifth embodiment of the invention. It is generally similar to the first embodiment, and therefore correlated reference numerals have been employed. The relative dimensions in the radial and longitudinal direction have been adjusted to take account of the dimensions of the

intended use, but this does not affect the principle of the device.

This embodiment differs in that the bolt 30 of the first embodiment is replaced with a length of threaded studding 36. This passes (as before) through the hole 24 in the compression member 22, through the hole 26 in the elastomeric member 10, and is received in the blind hole 28. A nut 38 is provided on the free end of the studding 36, tightenable against the compression member 22 to bring the compression members 20, 22 together.

It will thus be appreciated that the present invention offers a seal for use in a variety of annular widths which can provide sufficient sealing. Examples generally according to the first embodiment have been tested and have withstood a water pressure of 59 bar, without leakage.

It will be appreciated that many variations can be made to the above-described embodiments, without departing from the scope of the present invention. All such embodiments are intended to be encompassed by the present application.

CLAIMS

1. A gasket for sealing an annular space between two pipes, comprising an annular elastomeric member having a concave formation on at least one longitudinal end face, compression members adjacent the longitudinal end faces and connected via a plurality of securing means adapted to urge the compression members together, the compression member or members adjacent a concave formation on the elastomeric member including a corresponding convex formation.

2. A gasket according to claim 1 in which the elastomeric member is unitary.

3. A gasket according to claim 1 or claim 2 in which the elastomeric member also includes a concave formation on at least one radial face.

4. A gasket according to claim 3 in which the gasket further includes at least one filler member in the concave formation on the radial face.

5. A gasket according to claim 4 in which the filler member is elastomeric.

6. A gasket according to any preceding claim in which the securing means comprise threaded members passing through at least one of the compression members and through the elastomeric member.

7. A gasket according to claim 6 in which the threaded members are bolts.

8. A gasket according to claim 6 or claim 7 in which the threaded

members pass through both compression members and are retained by at least one nut.

9. A gasket according to claim 6 or claim 7 in which the threaded members extend into an internally threaded blind hole on one of the compression members.

10. A gasket according to any preceding claim in which the compression members are steel.

11. A gasket according to any preceding claim in which the steel compression members are unitary.

12. A gasket according to any one of claims 1 to 11 in which the steel compression members are divided into a plurality of individual arcuate members.

13. A gasket according to claim 12 in which individual arcuate portions on either side of the elastomeric member are staggered.

14. A gasket substantially as any one described herein with reference to and/or as illustrated in the accompanying drawings.

The Patent Office

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INVESTOR IN PEOPLE

Application No: GB 9817690.2 **Examiner:** Mr Nikki Dowell
Claims searched: 1 to 14 **Date of search:** 28 June 1999

Patents Act 1977
Search Report under Section 17

Databases searched:

UK Patent Office collections, including GB, EP, WO & US patent specifications, in:

UK Cl (Ed.Q): E1F F2B F2G F2P

Int Cl (Ed.6): F16J - 15/02, 15/10 F16L - 7/00, 7/02, 21/04, 55/132, 59/12, 59/14, 59/147

Other: Online : WPI, EPODOC, PAJ

Documents considered to be relevant:

Category	Identity of document and relevant passage		Relevant to claims
X,Y	GB 2,317,934 A	(Regal Rubber Company Ltd) see whole document	X:1-3,6-11 Y:12,13
X,Y	GB 814,022 A	(Muller) see especially figures 2 and 3	X:1,3-7,9-11 Y:12,13
Y	WO 96/36831 A1	(British Steel) see especially fig. 1 and page 2, lines 26 to 28	12,13
X,Y	WO 92/08915 A1	(Baroid Technology)	X:1,3,6-11 Y:12,13

X	Document indicating lack of novelty or inventive step	A	Document indicating technological background and/or state of the art.
Y	Document indicating lack of inventive step if combined with one or more other documents of same category.	P	Document published on or after the declared priority date but before the filing date of this invention.
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